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Introduction to dynamics:

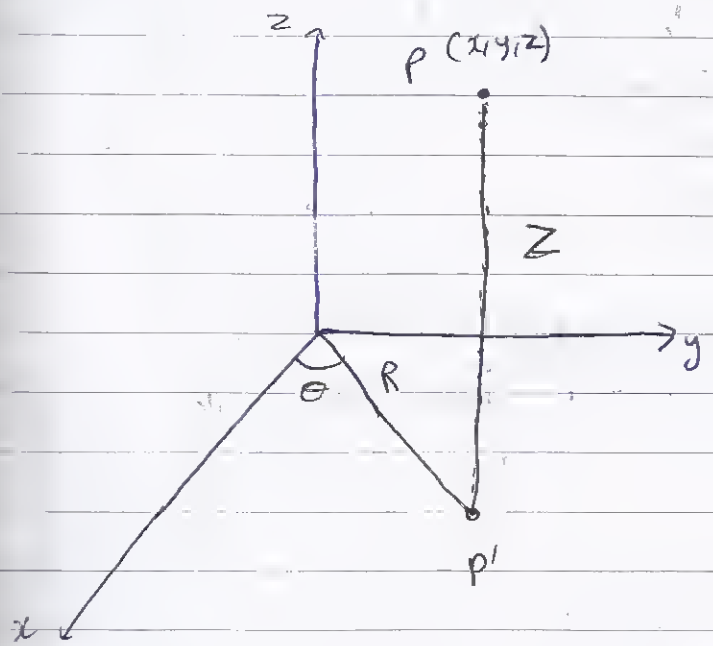
Dynamics is split into 2 parts:

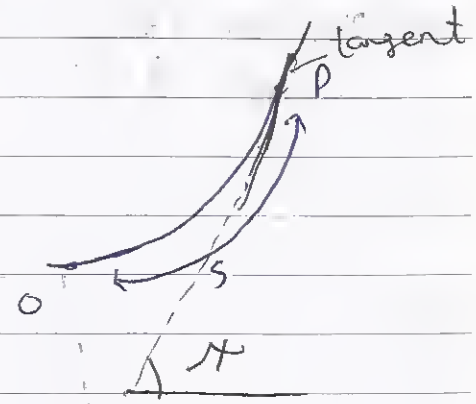
1- Kinematics: It deals with position, velocity and acceleration of the object (particle/rigid body)

2- Kinetics: It deals with the forces acting on the object.

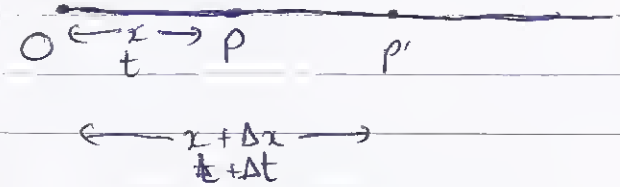
- We have 3 types of coordinates

1. Rectangular coordinates (x, y, z)
2. Cylindrical coordinates (R, θ, z)
3. Intrinsic coordinates (s, n)





Rectilinear motion



displacement $= (x+\Delta x) - x = \Delta x$

average velocity $= \frac{\Delta x}{\Delta t}$, instantaneous velocity $= \lim_{\Delta t \to 0} \frac{\Delta x}{\Delta t} = \frac{dx}{dt}$

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average acceleration $= \frac{\Delta v}{\Delta t}$, instantaneous acceleration $= \lim_{\Delta t \to 0} \frac{\Delta v}{\Delta t} = \frac{dv}{dt} = \frac{d^2x}{dt^2}$

Q 11.1 Pg. 613) $x = 1.5t^4 - 30t^2 + 5t + 10$ Find position, velocity and acc. at $t=4$

$t=4$ $x = 1.5(4^4) - 30(4^2) + 5(4) + 10 = -66\text{m}$

$v = \frac{dx}{dt} = 6t^3 - 60t + 5$ $t=4$ $v = 149\ \text{m/s}$

$a = \frac{dv}{dt} = 18t^2 - 60$ $t=4$ $a = 228\ \text{m/s}^2$

Q 11.6) $x = 2t^3 - 15t^2 + 24t + 4$ find

a) times when velocity is 0

b) position and total distance at $a=0$

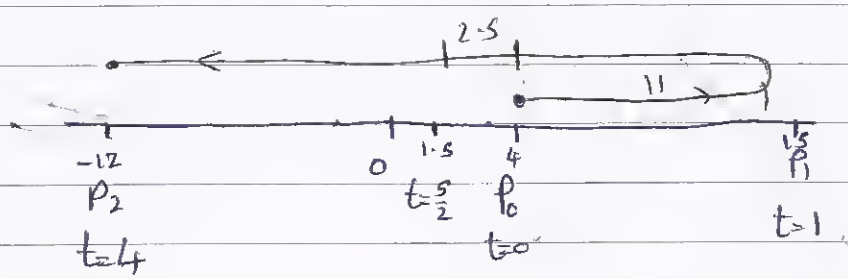
a) initial position P_0 at $t=0$ $x = 4\text{m}$

$v = \frac{dx}{dt} = 6t^2 - 30t + 24$ $v=0$, $6t^2 - 30t + 24 = 0$

$t = 1$ and 4 seconds

b) position at $t=1$ $= 15\text{m}$

position at $t=4$ $= -12\text{m}$



$a = \frac{dv}{dt} = 12t - 30$ $a=0$, $12t - 30 = 0$ $t = \frac{5}{2}$

x at $t=\frac{5}{2} = 1.5\text{m}$

distance travelled in $\frac{5}{2}$ seconds $= 11 + 11 + 2.5 = 24.5\text{m}$